

RFTST1000
Tag Tester V3.0

User's Guide



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1.- OVERVIEW

The RFTST1000 Tag Tester is a complete RF measurement system for non-contact characterization of smart labels («tags»). It consists of a small control unit containing all the electronics, an antenna, and a PC software running under Windows 95/98.

1.1.- FEATURES AND SPECIFICATIONS

Key features of the RFTST1000 are:

- Virtual *spectrum analyzer* display
- Frequency Generator mode
- *Tracking generator* with output level adjustment in dB.
- 0 to 50MHz operating frequency with 1 Hz frequency resolution
- 1 to 4 tracks for reference
- 1 or 2 markers with absolute value and increment (difference) display
- Cursor level and frequency display
- Configuration and data save/recall feature
- PC Serial Port communication
- Configurable video filter for smooth representation of signal plot
- Automatic Q measurement feature

1.2.- QUICK START

Follow the steps below for a quick start introduction to the RFTST1000

1. Install the RFTST1000 Software from the diskette. Insert it into the drive and *double-click* the Setup icon from the Windows Explorer. Follow the instructions that appear on the screen.
- 2.- Use the provided serial port cable to connect the RFTST1000 module to an available COM port in your computer (COM1 to COM4).
- 3.- Plug the TAGAN1000 antenna module into the main module through the BNC connectors. Plug the power supply into a wall socket. Plug the power cable (12Vcc) into the corresponding RFTST1000 connector.
- 4.- From the Program menu, select the *RFID->Tag_Tester* item. The Tag_Tester window appears on the screen.
- 5.- If the COM port is not COM1, change the value in the «Settings» option in the main menu.
- 6.- *Click* on the «auto» button in the «Display» section (middle right side of the window). A red trace will be visible in the Display. If you place a label on the antenna, its frequency response will be displayed.

1.3.- NOTES ON VERSION 3.0

Version 3.0 of tag tester software, adds the following new features

- Configurable (taps and bandwidth or auto mode) video filter
- RF output level calibrated in dB
- Grid display to provide a convenient way to record sets of measurements
- External trigger option

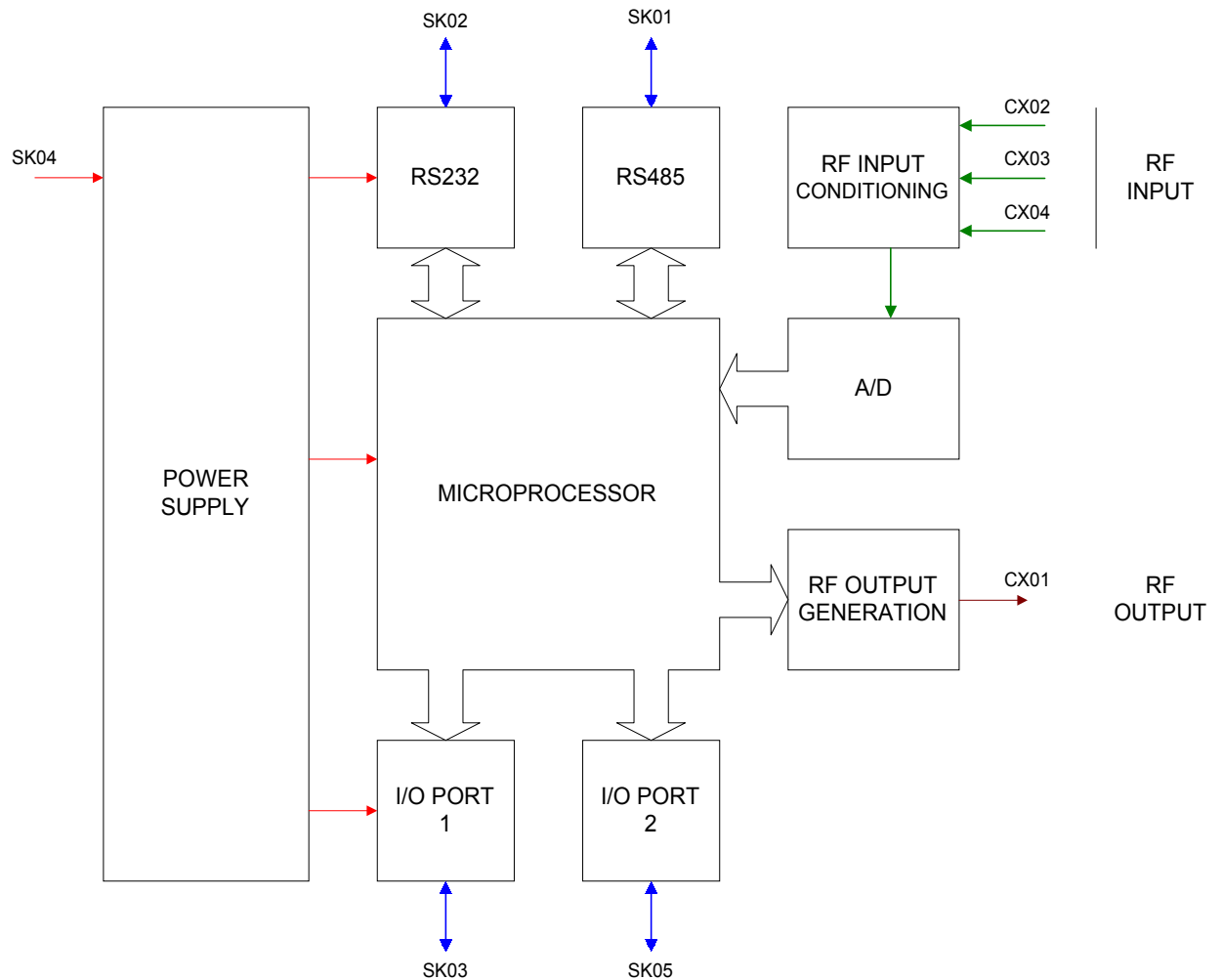
To be able to use the external trigger feature, a firmware update of the RFTST1000 tag tester must be made. Softrónica will supply the firmware update program upon request.

2.- ARQUITECTURE

This chapter describes the RFTST1000 hardware, external connections and working basics.

2.1.- TAG-TESTER RFTST1000 BLOCK DIAGRAM

The tester block diagram is shown on next figure.



The main blocks and subsystems are:

- RS232 interface.
- RS485 interface.
- Microprocessor.
- Power supply.
- Digital input and output circuits.
- Radio frequency output.

- Radio frequency inputs

The RS232 interface consists of a standard serial interface for point to point communications with a host computer. It is available through the communications connector (SK02 sub-D female), with TXD, RXD and GND signals.

In the same connector (SK02) there is a RESET signal to the microcontroller for programming purposes.

The RS485 input-output interface is used to connect several RFTST1000 modules to the same PC interface, or even with other RS485 equipment. The RS485 port is available in the communications connector (SK01 sub-D female). The signals are A-RS485 and B-RS485.

The whole unit is controlled with a microprocessor. Its functions are:

- RF output control
- RS232 and RS485 communication protocol
- A/D converter control
- I/O control

The Power Supply takes the supply input (+12Vcc) and generates the different regulated voltages needed for the rest of the circuits. The Power Supply is connected to SK04.

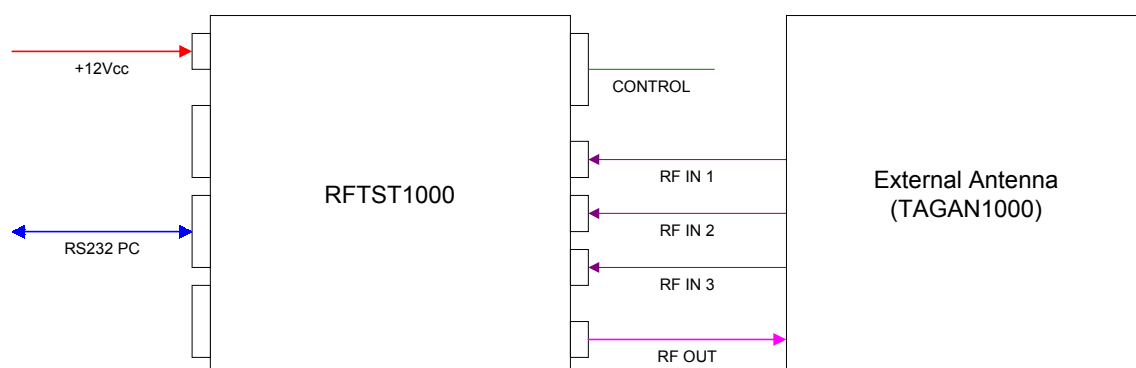
The I/O circuits make it possible to connect the RFTST1000 with external circuits for control or synchronization purposes. The connector SK03 in the rear of the unit includes 3 configurable digital I/O ports and 4 Analog input ports. SK05, in the front of the unit, includes 7 I/O configurable ports.

The RF output is amplitude and frequency controlled from the microprocessor.. Its output connector is CX01 (BNC type).

The RF inputs are connected to three logarithmic amplifiers providing a very wide dynamic range. The connectors are CX02, CX03, and CX04 (BNC type)

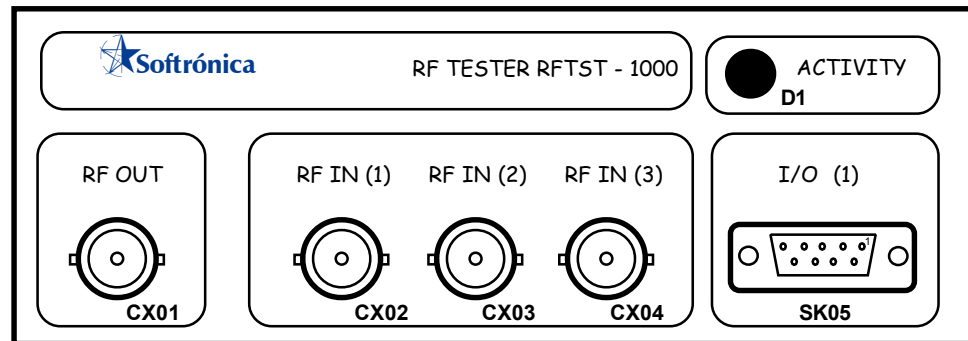
2.2.- EXTERNAL CONNECTION

In the figure it can be seen the basic external connection to the RFTST1000. The module is prepared to work with a +12Vcc external power source, so it is necessary to use a suitable Power Supply if it is going to be supplied from the 220Vac mains. The FALME1012 Power Supply is available from Softrónica.



The connection with a PC is made through a standard RS232 cable.

The RF I/O are available for connection to different kind of modules. It is possible to design modules to measure tags in laboratory, to continuously measure tags in production, or to measure magnetic field generated by antennas. The TAGAN1000 module is available as a standard and makes it possible to measure tags in laboratory environments.



Finally there is also a RS485 connection for integration of the RFTST1000 in control or production environments with other measurement equipment.

2.3.- I/O AND INDICATOR DESCRIPTION

2.3.1.- CONNECTORS IN THE FRONT PANNEL

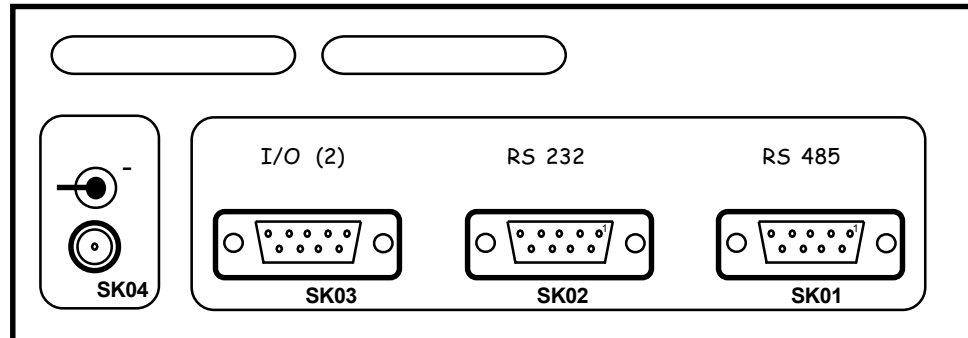
There are four BNC connectors in the front pannel for RF signals. They are used to connect the antennas or measurement instruments according to the test to be carried out.

- CX01 Radio-Frequency output
- CX02 Radio-Frequency input 1
- CX03 Radio-Frequency input 2
- CX04 Radio-Frequency input 3.
- SK05 Control I/O 1.
- D1 ACTIVITY (communication) indicator

CX01	Radio-Frequency output	BNC
	1. RF Output (center)	
	2. GND	
CX02	Radio-Frequency output 1	BNC
CX03	Radio-Frequency output 2	BNC
CX04	Radio-Frequency output 3	BNC
	1. RF Output	
	2. Masa	
SK05	Control I/O 1	Sub-D Female 9
	1. I/O 3. Trigger +	6. I/O 4
	2. I/O 5. Trigger -	7. I/O 6
	3. I/O 7	8. I/O 8
	4. I/O 9	9. GND
	5.- + 12Vcc (output)	

2.3.2.- CONNECTORS IN THE REAR PANNEL

In the rear of the unit it is possible to find the following connectors:



- SK01 RS485 Connector
- SK02 RS232 Connector
- SK03 Control I/O 2
- SK04 +12Vcc power supply connector

SK01	RS485 Connector	Sub-D Female 9
	1. PROG	6. VPP
	2. RS485 A	7. RS485 B
	3. NC	8. NC
	4. +12V	9. NC
	5. GND	

SK02	RS232 Connector	Sub-D Female 9
	1. NC	6. NC
	2. Tx Data	7. Reset
	3. Rx Data	8. NC
	4. NC	9. NC
	5. GND	

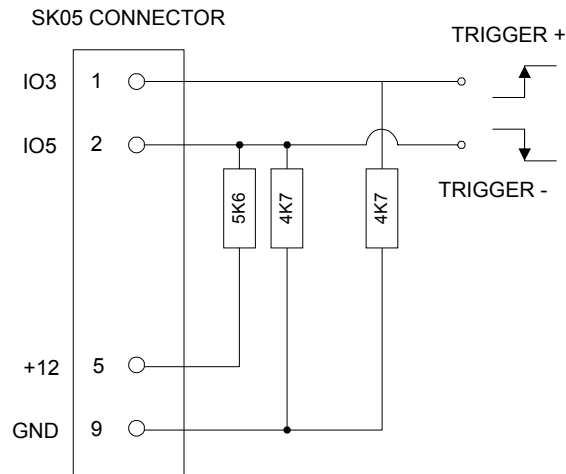
SK03	Control I/O 2	Sub-D Female 9
	1. A/D 8	6. A/D 7
	2. A/D 6	7. A/D 5
	3. I/O 0	8. I/O 1
	4. I/O 2	9. GND
	5. + 12Vcc (output)	

SK04	Power Supply	«battery type» connector
	1. + 12 Vcc.	
	2. GND	

WARNING. BE VERY CAREFUL TO AVOID ERRORS WHEN CONNECTING THE 4 SUB-D CONNECTORS. DAMAGE TO THE UNIT MAY HAPPEN IF YOU MISTAKE THEIR POSITION.

2.3.3.- EXTERNAL TRIGGER OPERATION

If the external trigger option is selected from the menu bar (see section 3.5), the measurement starts after a digital edge (rising or falling) is detected in one of the digital port inputs. To use the trigger feature, the following circuit must be mounted:



When the «sample» button is pressed, and the trigger option is enabled, the RFTST1000 waits for a trigger signal on IO3 or IO5. The signalling LED of the unit turns yellow. If after a time out period, the trigger signal is not received, the LED goes to red, and the sample button has to be pressed again.

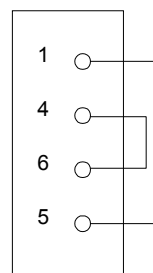
If there is a valid trigger input, the LED turns green, and a sample is taken. **This operation requires the firmware update of the RFTST1000.** See next section.

2.3.4.- FIRMWARE UPDATE

The firmware update of the RFTST1000 is made with a PC program supplied by Softrónica, through the standard PC serial port cable used to control the unit. To update the firmware, follow these steps:

- Turn off the RFTST1000 power supply
- Attach the following cable to the SK01 connector

SK01 CONNECTOR



- Attach the standard communication cable to the RS232 connector and to the PC
- Turn on the RFTST1000 power
- Run the update software on the PC

3.- OPERATION

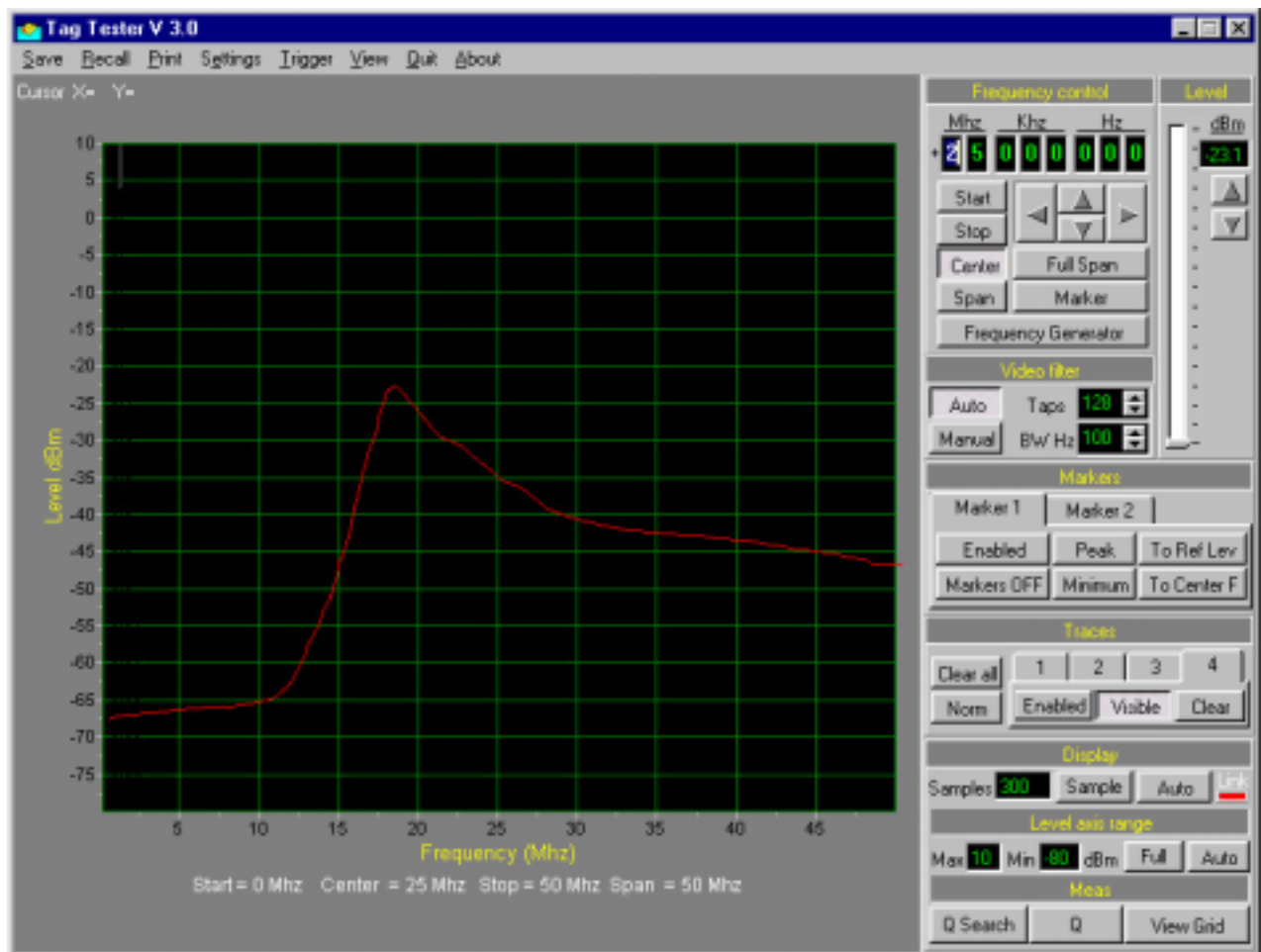
This chapter explains how to use the RFTST1000 software.

3.1.- RFTST1000 START-UP

To run the RFTST1000 Software, *double-click* the *Tag_Tester* icon in the *SOFTRONICA->RFID* folder, or select *Programs->Rfid->Tag_Tester* from the Windows menu.

3.2.- RFTST1000 CONTROL WINDOW

The program main window is divided in three zones, as can be seen in the next figure.



- **Display zone (1)** Presents all the graphical (level-frequency curves or «traces») and numerical (marker or cursor positions, axis ranges) information related with the data received from the RFTST1000.
- **Control Zone (2)** Contains all the elements (buttons, selection boxes, data input) needed to control the appearance and behaviour of the Display Zone.
- **Menu (3)** Menu operations

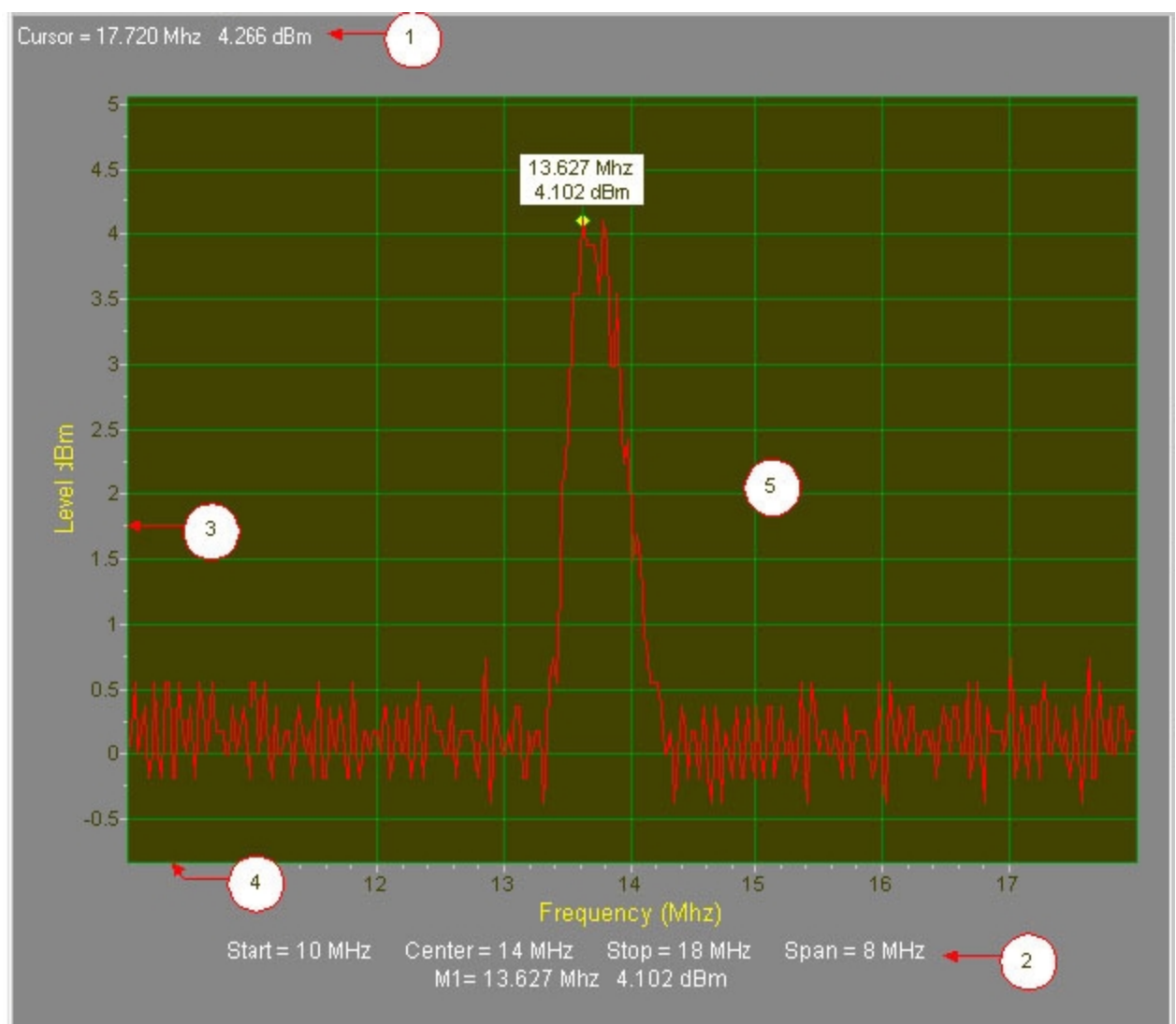
3.3.- DISPLAY ZONE OPERATION

The display zone (see next figure) is used to represent all the data received from the RFTST1000. The received data is stored in «traces» (there are four available traces), according to the settings in the control zone (see section 3.4). The traces can be represented in the display in a «spectrum analyzer» format.

There is also some numerical information related to the received data or the display properties. This information is also displayed in this part of the screen:

- X and Y axis settings. Minimum and Maximum values and span
- Cursor position. Level and frequency as the cursor moves through the display
- Markers position. Level and frequency for both markers when active
- Markers difference. Difference in level and frequency when both markers are active
- Q Factor. Q measurement results

This is depicted in the following figure.



- **Cursor Position in numerical format (1)** It displays level in dBm and frequency in MHz corresponding to the point signalled by the cursor.
- **Settings and Markers (2)** It displays the following information:
 - Start and Stop* (minimum and maximum) frequencies in MHz
 - Center* frequency. The frequency corresponding to the middle of the display
 - Span*. The difference between minimum and maximum frequencies.
 - M1*. The level (dBm) and frequency (MHz) corresponding to Marker 1 if enabled
 - M2*. The level (dBm) and frequency (MHz) corresponding to Marker 2 if enabled
 - M2- M1*. The difference in level and frequency between markers 1 and 2 if both are enabled
- **Y axis (3)** The Y axis represents level in dBm. The minimum and maximum level values are displayed.
- **X axis (4)** The X axis represents frequency in MHz. The minimum and maximum frequency values are displayed.
- **Display Area (5)** The active traces and marker information are displayed in this area.
- **Q Factor (not shown)** Q factor measurement results (f_0 =Central frequency, D_f =3dB bandwidth, Q =resulting Q factor). It is displayed in a panel in the upper-right of the Display Area.

There are some display control operations performed with the mouse on the Display Area. They are described in the next paragraph.

- **Zoom in** To view more in detail some part of the display area, *left-click* on the upper left corner of an area, and *drag* to the lower right corner. The rectangle defined will be displayed in the whole display area.
- **Zoom out** To restore the original display area, *click and drag* in the opposite direction (from the lower right to the upper left).
- **Vertical/Horizontal scroll** To scroll the display area, *right-click* with the mouse and *drag* in the appropriate direction.
- **Cursor marker** To display the level and frequency of a point in a trace, *click* on the desired point on the trace.

3.4.- CONTROL ZONE OPERATION

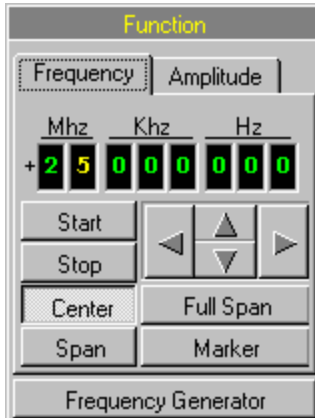
In this section we will describe the operations performed in the different elements included in the control zone.

3.4.1.- FREQUENCY CONTROL

The operations related with the X axis of the display are performed in this zone. It is possible to select the start, stop and center frequency and span. To change one parameter, the first thing to do is to select it through the four parameter buttons:

- *Start*: Start Frequency. The frequency in the left of the X axis.
- *Stop*: Stop Frequency. The frequency in the right of the X axis.
- *Center*: Center Frequency. The frequency in the middle of the X axis.
- *Span*: Span. Difference between start and stop frequencies.

Once selected, the current parameter value is displayed in the 8 frequency digits. It is possible, then, to change the value in several different ways:



- **Keyboard:** Through direct typing of the digits on the keyboard. The value takes effect when hitting the «Enter» key or when reaching the last digit.
- **Mouse:** Using the four «arrow» buttons. To select the digit to be changed *click* the left and right arrows. To change the value, *click* the up and down arrows.

And also with the buttons:

- **Full Span:** To restore the «full span» condition (0-50MHz).
- **Marker:** The start and stop frequencies are adjusted according to the Marker 1 and Marker 2 positions.

Once a parameter is changed, the others are recalculated in accordance with the change.

There is also a *Frequency Generator* button for direct fixed frequency output from the generator. The RFTST1000 will generate the selected «center» frequency. While this button is in the «down» state, it is possible to change the generated amplitude and output frequency, by means of the «output control» and «centre frequency» controls.

3.4.2.- AMPLITUDE CONTROL AND Y DISPLAY RANGE

The Tracking generator output level is controlled here. This parameter is very useful when trying to measure energized labels with different levels of electromagnetic field applied.



The output RF level indication is calibrated in dBm, and it is possible to change the value with the slider or with the up-down arrows.

The Level axis range controls allow to change the amplitude display characteristics. With the Max and Min Edit controls, it is possible to change the displayed range.



With the *Full* button, the whole range (-80 to 10 dBm) is displayed.

With the *Auto* button, the programs select the best range for the current displayed signal.

3.4.3.- DISPLAY CONTROL

The Display control is used to select the number of points displayed in the Display Zone.



There are also three buttons to perform the following operations:

- *Sample*: Take a «snap» sample from the unit. The complete trace (or traces) is filled with new data.
- *Auto*: The traces are continuously filled with new data.

The Link indication is green when the communication link with the unit is established. If there is a communication error, the indicator turns red.

3.4.4.- TRACES CONTROL

The Traces control is used to manage the four traces available for displaying current data or previously stored reference data.

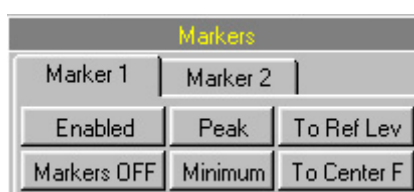
There are five buttons to control every trace.



- *Enabled*: When selected, sampled current data is stored in the the corresponding trace. When deselected, the contents of the trace are «freezed» with the last data.
- *Visible*: The trace is visible or invisible.
- *Clear*: The contents of the trace are cleared.
- *Norm*: The current trace data is «normalized» i.e. its data is subtracted from a reference stored in trace number 4. This option works in traces 1 to 3.
- *Clear all*: The contents of all the traces are cleared

3.4.5.- MARKERS CONTROL

The Markers menu controls the position and characteristics of the two available markers.



- *Enabled*. The corresponding marker is enabled (it appers on the Display Zone) or disabled (it is hidden).
- *Peak*. The corresponding marker is automatically positioned on the highest Y-axis value of the Display Zone.
- *Minimum*. The corresponding marker is automatically positioned on the lowest Y-axis value of the Display Zone.
- *To Ref Lev*. The Display Zone Y-axis is moved so that its reference (the highest value) is set to the markers value.

- *To Center F.* The Display Zone X-axis is moved so that its center frequency (the middle value) is set to the markers position. The span is maintained without changes.
- *Markers OFF.* Both markers are hidden.

3.4.6.- MEASUREMENT

With the Q measurement feature, the current active trace is analyzed. Its peak frequency is located and both 3dB points are determined. The Q factor is calculated and displayed in the display zone. To hide the Q factor data, just *click* on the corresponding panel.



There are two buttons for Q measurement.

- *Q Search* The current trace is analyzed and the display X and Y axes are reconfigured for optimum Q results. Then the Q, fo and 3dB bandwidth parameters are calculated.
- *Q* The Q, fo and 3dB parameters are calculated with the current display settings.

If there is not any peak in the current trace, an error message is displayed.

With the *View Grid* button, a grid appears on the screen. The function and the options of the grid are described in next section.

3.4.7.- GRID

The following controls appear when pressing the *Grid* Button.



It is possible to save a set of measurements by just pressing the *Collect Data* button. Then the measurements taken from the current trace are added to the grid, and can be saved to a file, with the *Save File* button.

The parameters to be stored are selected with the set of check controls, and the grid can be restored with the *Clear Grid* button. You can also overwrite a measurement by just typing a new value in the Ref column of the grid.

It is also possible to add a comment to the file by just writing it into the corresponding edit box.

3.4.8.- VIDEO FILTER

The Video Filter controls are provided to give a smooth display of the current trace, by filtering the received data. The digital filter parameters can be manually selected, or can be optimised by the application for the current display settings.

The measurements taken with a proper video filter are much more consistent and repetitive. The following controls are provided.



- *Auto* The parameters of the digital filter (number of taps and bandwidth) are automatically adapted to the current display X and Y axis settings.

- *Manual* The number of taps and bandwidth are selected with the spin controls to the right. It is important to be very careful when manually selecting the parameters, because a too narrow bandwidth can result in signal distortion.

3.5.- MENU

The menu main options are depicted in the following figure.

Save Recall Print Settings Trigger View Quit About

- *Save/Recall* Saves and recalls the configuration and traces data. There are four «quick» configurations (Config1..Config4) and a «file» option to save the current configuration/data in a file under a user given name.
- *Print* Sends the current display to the printer.
- *Settings* Selection of COM port (COM1 to COM4). The selection is stored and the program starts with the selected com port.
- *Trigger* Enables or disables the external triggering of the device. See section 2.3.3.
- *View* The controls on the right of the screen have been implemented as floating controls. In this way, they can be moved to any position of the screen, or even hidden. If they are hiding, they can be restored with this option of the menu.
- *Quit* Exits the program
- *About* Displays program version information.

4.- MEASUREMENT BASICS

This chapter explains how to make simple measurements with the RFTST1000 system.

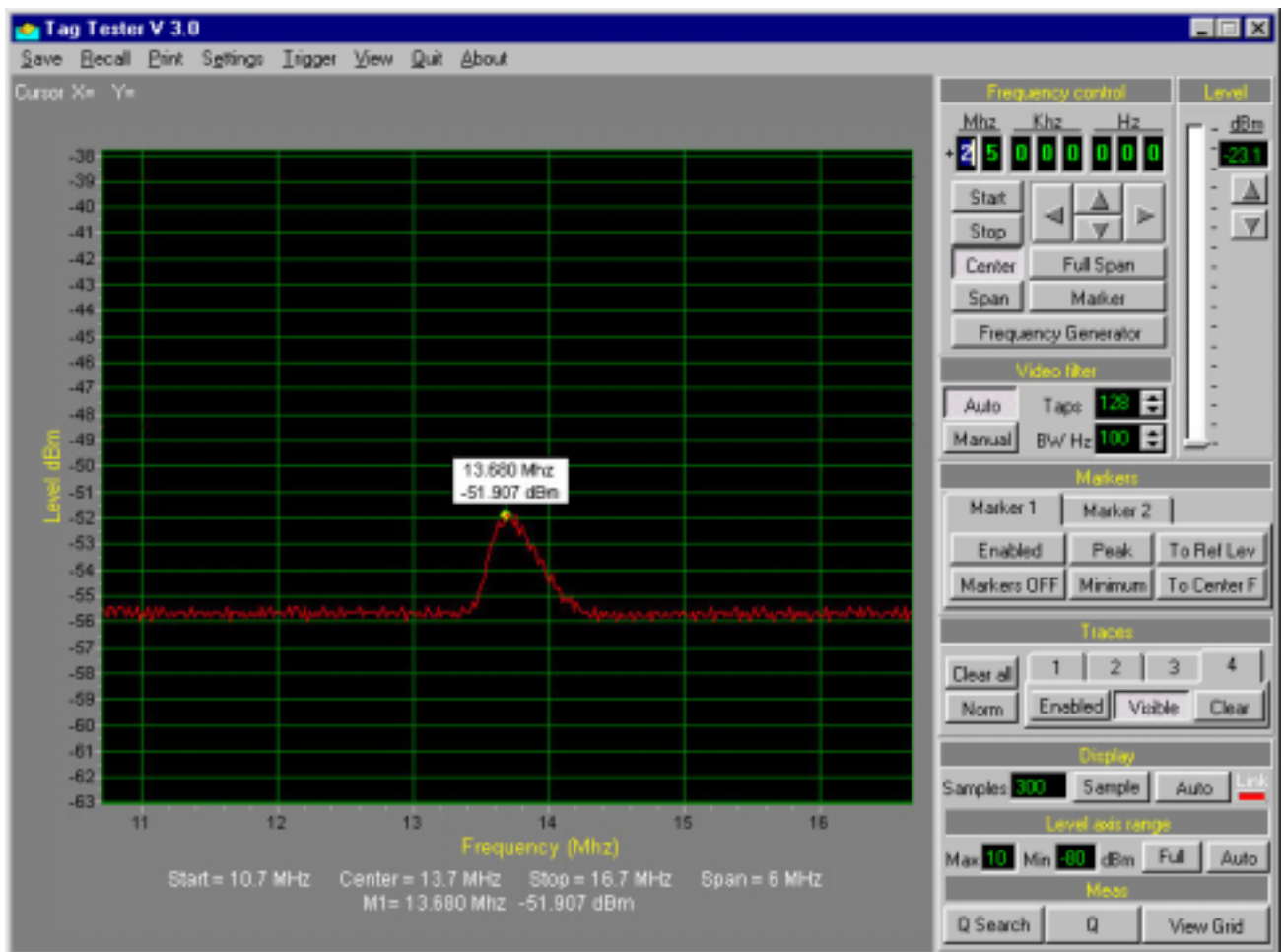
4.1.- TAG RESONANT FREQUENCY MEASUREMENT

To make a simple measurement of a tag resonant frequency, use the TAGAN1000 module connected to the RF connectors of the RFTST1000. The steps to follow are:

- Put the tag on top of the TAGAN1000 module
- Select the trace 1 in the software, and *click* the «ENABLE» and «VISIBLE» buttons in the Trace Control Zone.
- *Click* the «AUTO» button in the Display Control Zone.
- *Click* the «ENABLED» button in the Marker Control Zone.
- *Click* the «PEAK» button in the same zone.
- *Click* the «TO CENTER F» button in the same Zone.

The frequency will be in the center of the screen, and there will be a marker displaying the level and frequency values. You can also make a manual zoom by dragging from the upper-left to the lower-right part of the Display Zone.

It is also possible, in this condition, to make changes in the output RF level (tracking generator amplitude), to see how it affects the value of the resonant frequency. The correspondig display should look like this:

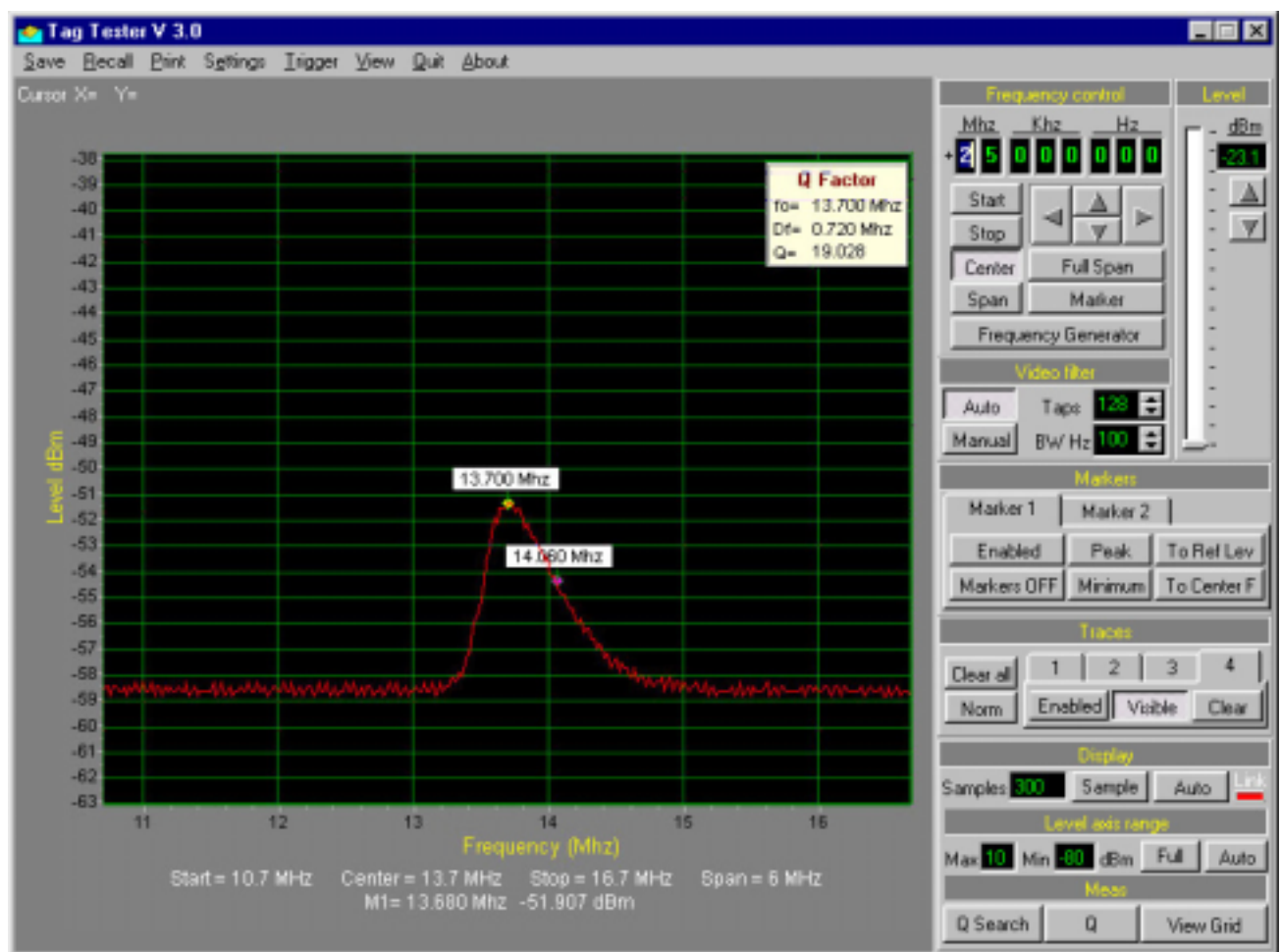


4.2.- QFACTOR MEASUREMENT

To make a simple measurement of a tag Q Factor, use the TAGAN1000 module connected to the RF connectors of the RFTST1000. The steps to follow are:

- Put the tag on top of the TAGAN1000 module
- Select the trace 1 in the software, and *click* the «ENABLE» and «VISIBLE» buttons in the Trace Control Zone.
- Click the «SAMPLE» button. The corresponding trace appears on the display zone.
- Click the «Q Search» button. The display settings are changed. The peak frequency and 3db point (see section 3.4.5 for a detailed explanation of Q factor measurement) are marked on the Display Zone. The calculated Peak Frequency (fo), 3db bandwidth (Df), and Q factor (Q) are displayed in a panel in the upper right of the display zone.

The Q factor is calculated as f_0/Df . To hide the Q Factor panel, *click* on it. The display should look like this:



5.- INSTALLATION

This chapter explains how to install the RFTST1000 software.

The process is very simple. You just have to *double-click* the «SETUP» program in the disquette supplied to run the installation program. The program will be installed in the «RFID» folder.

Less than 1MB of free disk space is needed to install all the necessary files. The software runs under Windows 95/98.

6.- TROUBLESHOOTING

If you find any problem when installing your RFTST1000 system, please, follow these steps.

6.1.- COMMUNICATION PROBLEM

If there is no communication between the PC and the RFTST1000 module (the «link» indicator goes red when operating the unit), check the following:

- Check the Power Supply connection (220Vac or +12Vcc plugs)
- Check the Communication Cable.
- Check if it is connected in the corresponding PC Serial Port (the one selected in the «SETTINGS» option in the main window.
- Check if it is connected in the RS232 connector in the RFTST1000 unit

6.2.- MEASUREMENT PROBLEM

If the display zone data doesn't seem to be correct, check the following:

- Check the connection with the antenna or transducer (RF IN and RF OUT 1,2 and 3)
- Check the measurement range in the Display Zone (X axis and Y axis limits). Make a «restore» operation in this area (drag with the mouse from the right-lower to the left-upper part of this zone), or try the «autorange» and «full span» operations.
- Check if there is any enabled trace
- Check the «ACTIVITY» led in the front pannel of the RSTST1000. If it doesn't flash, try to see if there is a communication problem (6.1 section).

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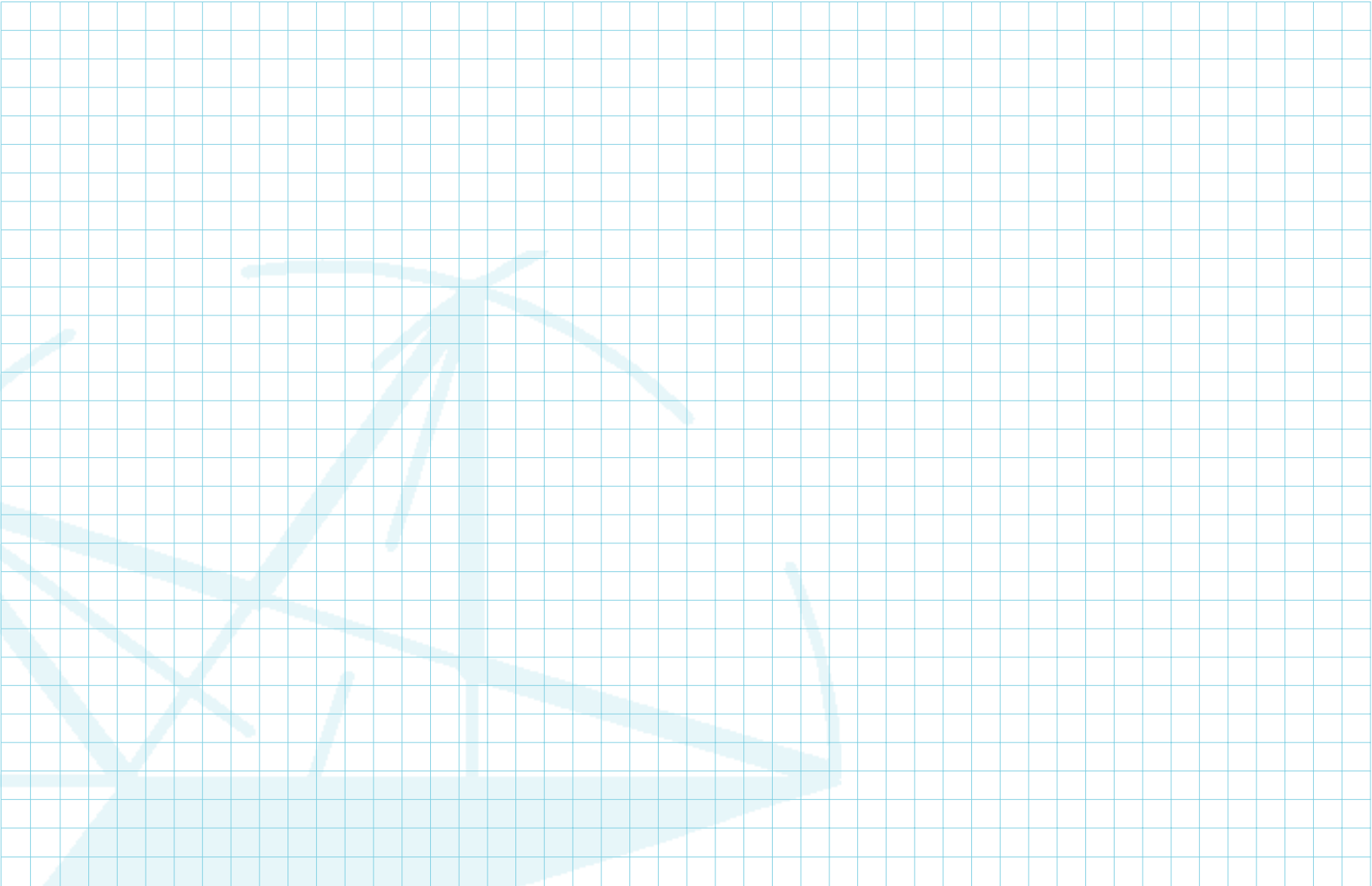
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